SECTION 15.35: ERGONOMICS
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Ergonomics is the study of work. The goal of an ergonomics program is to **make the job fit the person, not make the person fit the job**. This goal is accomplished by redesigning the job or tool to reduce the job demands of high force, repetition, and awkward postures. By improving the fit between the worker and the job, we not only contribute to the well being of the worker, we are also improving productivity.

In dealing with ergonomics, the initial task of identifying the causes is often overshadowed by the more difficult task of deciding on the most effective method of control or intervention. There is seldom a simple, single change to be made. Perfect solutions are rarely available and design decisions often involve compromises and trade-offs. The most efficient way to proceed in administrating ergonomic intervention is as follows:

1. Perform a thorough examination (job analysis), to determine the specific problem. Interview workers to find out what problems they are encountering while working at their workstation.
2. Evaluate, select, and implement the most appropriate intervention(s), supported with training and education.
3. Begin conservative medical management, as appropriate.
4. Monitor progress. Continually interview employees to find how corrective measures have helped, as well as asking if additional steps need to be taken.
5. Continue to adjust or refine the scope of the intervention as needed. Fine-tune any additional ergonomic corrections that need to be made.

A good ergonomic program will target the following objectives.

1. **Reduction of extreme joint movement**. Work activities should ideally be performed with the joints at about the midpoint of their range of movement. For example, when force is being applied by the hand, the wrist should be kept straight and the elbow bent at a right angle. All side-to-side deviations of the wrist should be avoided. The hands should be kept in line with the forearms. At least three methods exist for reducing deviations of the wrist. These include:

    - **Altering the tool or controls** by bending the tool or handle instead of the wrist.
    - **Moving the part** in front of the worker so the wrist can be straight.
    - **Moving the worker** and changing the position of the worker in relation to the part.

2. **Reduction of excessive force levels**. Jobs should not require the worker to exert more than 30% of his or her maximum force for a particular muscle, in a prolonged or repetitive way. Three general approaches to controlling job forces are:

    - **Reducing the force required** (keep cutting edges sharp, use weaker springs in triggers, use jigs and clamps instead of hands to grip parts).
    - **Spreading the force** (use trigger levers rather than single-finger push buttons and allow the worker to alternate hands).
    - **Getting better mechanical advantage** (use stronger muscle groups and use tools with longer handles).

3. **Reduction of highly repetitive and stereotyped movements**. Since highly repetitive and stereotyped movements contribute to CTD's (Cumulative Trauma Disorders or referred to as MSD's Musculoskeletal Disorders), potentially aggravating production and design factors must be identified and altered to reduce the repetitive levels of a work cycle. Counter-measures include limiting the duration of continuous work or restructuring of work methods. In general, jobs that

have a cycle time of less than 30 seconds and take at least 50% of the workers time in a given cycle should be considered as posing a risk for CTD's. Several approaches may be taken to reduce rates of repetition:

- **Task enlargement**. Restructure jobs so that each worker has a larger and more varied number of tasks to perform.
- **Mechanization**. The use of special tools with ratchet devices or power drivers can reduce stressful repetition.
- **Automation**. Repetitive tasks are performed best by a machine. To be cost effective, this must typically involve a high volume, long-term production process design of workstation.

In order to accomplish the reduction of extreme joint movements, excessive force levels, and highly repetitive movements, the workstation should be designed to fit the person. Guidelines for workstations are as follows:

Workstations

An ergonomic workstation should accommodate a vast majority of the people who work on a given job and not merely the average. A work station that is adjustable and was either designed or selected to fit a specific task should be experienced as relatively comfortable by 90% to 95% of the worker population. The workspace should also be large enough to accommodate the full range of required movements.

To avoid static loading of muscles, good workstation design should permit the worker to adopt several different but equally healthy and safe postures, which still allow performance of the job. Ideally, a worker should be able to choose either a sitting or standing position. Sitting is best for tasks that require fine precision work, while standing is best for tasks that require a large space to be covered or large forces to be exerted. Arm rests and footrests should be supplied when appropriate.

Controls, Tools, and Materials

Controls, tools, and materials should be placed between shoulder and waist height to be easily reached and manipulated. Reaching above shoulder level or behind the body should be avoided. All reaching should be below and in front of the shoulder. As a general rule, for most types of industrial jobs, the work area should be about 2-4 inches below the elbow when standing or seated in an erect posture. The work areas may be raised 2-4 inches above the elbow for very precise or delicate work, whereas for heavy manual-assembly jobs, the work surface should be 4-5 inches below elbow height. For jobs where the work surface is elevated above the elbow height, adjustable pads may be provided for resting the forearms.

Chairs

Chairs that are correctly designed for the job and the person are also important. A chair that is inappropriate is not only a source of discomfort, which can affect productivity, but in the long run can contribute to back, neck, and leg problems. The seat height, backrest, and footrest should be adjustable to accommodate 90% of the population and the adjustments should be simple and easy to perform. The height of chairs should be adjusted so that the thighs are horizontal, feet rest on the floor, and the arms and hands are comfortably positioned at the keyboard or work surface. The backrest should be positioned so that it supports the lower back and fits the curvature of the spine. People should frequently change their seated position throughout the day.

Lighting

Overall levels of lighting in work environments should be between 300 and 500 lux, with dual level switches. Task lamps should be provided where necessary. Indirect lighting or parabolic fluorescent fixtures should be used in open spaces.

Video Display Terminals

Screens on all video display terminals should be positioned to minimize glare and reflections from overhead lights, windows, and other light sources. The display should be adjusted so that the top of the screen is slightly below eye level. The contrast or brightness of the screen should be placed at a comfortable level. Where it is impossible to avoid reflections or adjust lighting, an anti-glare filter placed over the screen can be helpful.

Work Smart

In addition to these corrective measures, a worker must also work smart. A worker should change position, stand up, or stretch whenever feeling tired. Rest the eyes occasionally throughout the workday to alleviate eyestrain. Finally, try to keep a soft touch on keyboards and keep the hands and fingers relaxed.